Incongruence between self-rated health and chronic disease risk amongst rural Nicaraguan women experiencing an epidemiological transition

Honors Research Thesis

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Introduction

Self-rated health (SRH) is a single-item, ordinal measure with five levels that is widely used as a proxy for measured health status in population health and epidemiological research (Zajacova and Dowd, 2011). Typically worded as "In general, would you say your health is" with potential responses being "excellent," "very good," "good," "fair," or "poor" (DeSalvo et al., 2011), SRH is a subjective, non-specific measure of respondents' perceptions of their health experience (Mavaddat et al., 2011). Its non-specificity means it can integrate perceptions of physical, mental, and social well-being which are informed by cultural beliefs and knowledge regarding health and disease (Böhme and Renneberg, 2015; Fernandes et al., 2020). In wealthy, highly industrialized contexts, SRH has proved a reliable predictor of numerous health outcomes including quality of life, disability, and non-communicable diseases (e.g., cardiovascular disease, stroke, lung disease), as well as overall mortality among the elderly (Noh et al., 2019; Perruccio et al., 2012; Yaya et al., 2020). Its reliability in high-income settings, ease of use, and low cost in comparison to objective measures of health, led to its adoption in population health studies in low- and middle-income countries (LMIC) (Idler and Benyamini, 1997) where it has been associated with social capital, food insecurity, depression, and long-term chronic disease or disability (Perez et al., 2018; Szwarcwald et al., 2005). Despite its widespread use, the non-specific and subjective nature of the instrument has led some to question how the local context influences which aspects of health it best predicts (Ansari and Berg-Beckhoff, 2019; Mavaddat et al., 2011: Wu et al., 2013). This concern is especially relevant in LMICs such as Nicaragua, which, in recent years have experienced rapid economic change and a broadened disease profile that includes long-standing endemic infectious diseases along with newer diet- and stress-related chronic diseases, i.e., an epidemiological transition (Alicea-Planas et al., 2016; CIA, 2021; Laux

et al, 2012; Robinson, 1997). Thus, the goal of this study was to explore the relationship between SRH and objective measures of physical and mental health among a sample of rural Nicaraguan women.

The Epidemiological Transition in Latin America

The epidemiological transition describes a shift in disease patterns where infectious diseases are gradually displaced by chronic, degenerative diseases as the principle cause of morbidity and mortality (Mascie-Taylor, 2012). The epidemiological transition is closely associated with demographic and socioeconomic changes (i.e., economy and demography) and the related nutrition transition where the diet shifts from a reliance on traditional high fiber roots and cereals to foods containing refined sugar and salt that are rich in saturated fats and calorically dense (Mascie-Taylor, 2012; Pietro et al., 2015). Also related to shifts in the economy, is a downward trend in physical activity due to changes in labor (i.e., shift from rural agricultural work toward urban service-type jobs) (Mascie-Taylor, 2012; Pietro et al., 2015).

The Latin American region has been described as experiencing a *delayed epidemiological transition* which is characterized by a recent, rapid decline in overall mortality rates, as evidenced by increasing life expectancy, sustained high fertility rates, and an increased prevalence of chronic disease (Mascie-Taylor, 2012; Omran, 2005). An example of this rapid transition is seen in the replacement of diarrheal diseases and lower respiratory infections as the top two causes of disability-adjusted life years (DALYs) in the region in the 1990s followed by ischemic heart disease becoming the leading cause of mortality in 2010 (GBD, 2013). In fact, cardiovascular diseases are now the leading cause of death and disability among men and women in the Americas (Rivera-Andrade and Luna, 2014; Ordunez et al., 2015 as cited in PAHO, 2017).

However, there is great variability in the pace of this transition across the region. For example, countries such as Brazil, Chile, Uruguay, and Mexico are already far along in the transition and exhibit disease profiles like those seen in wealthy, highly industrialized countries. On the other hand, countries such as Guatemala, Nicaragua, and Peru, are in an intermediate state characterized by a continued high rate of infectious disease alongside an increasing rate of chronic and degenerative disease or dual burden of disease (Albala and Vio, 1997; Alicea-Planas et al., 2016; Campos et al., 2015; Huicho et al., 2009).

In Nicaragua, between 1992-1995, mortality from cardiovascular disease increased from 64 to 71 per 100,000, mortality from hypertensive diseases rose from 3.1 to 10.8 per 100,000, and mortality from diabetes went from 8.9 to 9.6 per 100,000 (PAHO, 2001). Among Nicaraguan women, the rate of obesity, which is associated with many of these chronic conditions, increased from 18% in the early 2000s to 27% in 2016. In fact, the WHO (2016) projected that by 2025, over 30% of Nicaraguan women will be obese. As of 2014, 27% of deaths among adults was attributed to diseases of the circulatory system (PAHO, 2014). Among Nicaraguan women, the estimated prevalence of hypertension is 33% (Alicea-Planas et al., 2016) and, in rural zones, the prevalence among all adults is approximately 29% which is similar to the rate of hypertension in wealthier Latin American countries and in the United States (Laux et al., 2012). Yet, Nicaraguans continue to suffer from high rates of infectious disease including bacterial diarrhea, hepatitis A, typhoid fever, dengue fever, and malaria (CIA, 2021; Mascie-Taylor, 2012). In this way, Nicaragua can be accurately characterized as experiencing a delayed epidemiological transition and dual burden of disease.

SRH in the Context of an Epidemiological Transition

National-level health surveys, including the Demographic Health Survey (DHS), used to assess population health in many LMICs, employ a handful of objective health measures (e.g., height, weight, anemia status) and SRH as predictors of morbidity and mortality risk. Data from these surveys are used by governments to, "support evidence-based policy development, and in the planning and monitoring of health and development programmes in low- and middle-income countries" (Corsi et al., 2012). Thus, it is important to understand the extent to which SRH serves as a proxy of actual morbidity and mortality in these settings. Yet only a small number of studies have explored this relationship in these contexts including in the Latin American region (De Maio, 2007; Hurtado et al., 2010; Nuñez et al., 2020; Underraga et al., 2010).

In wealthier Latin American countries, well-along in the epidemiological transition, data indicate SRH is associated with chronic disease risk. For example, in Brazil, SRH was positively associated with diabetes, heart disease, and other chronic conditions, as well as overall life expectancy (Camargos et al., 2008; Szwarcwald et al., 2005). In Chile, SRH was associated with the number of comorbidities among older men and women (Campos et al., 2015).

Fewer studies have explored the relationship between SRH and morbidity/mortality risk in poorer countries in the Latin American region (Kallestal et al., 2020; Perez et al, 2018) where the epidemiological profile is still rapidly changing. In such contexts, including Nicaragua, SRH is associated with food insecurity, as well as socioeconomic status, unemployment and educational attainment with poorer, less educated people reporting poorer SRH (Perez et al., 2018; Szwarcwald et al., 2005). Data from Guatemala indicates that SRH declines with age among men and women, and that as women became more aware of connections between overweight/obesity and disease risk, they tended to report worse SRH and more chronic

conditions compared to men (Yount et al., 2010). This study highlights how knowledge and awareness of chronic conditions shapes perceptions of health and how gender impacts health perceptions (Yount et al., 2010). Another Nicaraguan study focused on building social capital in post-conflict Nicaraguan communities found that social capital was positively associated with health and civic behaviors and, in turn, SRH (Brune and Bossert, 2009).

Under conditions of rapid epidemiological change and the dual burden of disease, it is reasonable to ask what SRH reflects. This study asks the question of whether SRH is a suitable proxy for objective measures of morbidity, specifically risk of chronic disease, in populations experiencing a rapid epidemiological transition.

Materials and Methods

Background

This study was conducted in Nicaragua, the second poorest country in the western hemisphere, where 24.9% of the population live below the national poverty line (United Nations Development Programme, 2020) and 27% of rural households fall below the extreme poverty line (<$2 per day) (IFAD, 2012). The Nicaraguan economy experienced several rapid transformations during the latter part of the 20th century, which, in turn, altered the livelihoods of the Nicaraguan people (Robinson, 1997). The country underwent a multifaceted transition from the 1960s to the 1990s (Robinson, 1997). Twenty years of conflict culminated in the 1979 revolution that led to the removal of the Somoza dictatorship (Lancaster, 1992). This revolution stemmed from growing discontent due to rampant poverty and evident inequality between socioeconomic classes (Lancaster, 1992). The Sandinistas, the opposing group to the Somoza administration, were met with numerous challenges including from the United States government

who provided funding and training to the Contras (anti-Sandinistas) (Lancaster, 1992). The United States withdrew from the Contra War in 1988 (Kinzer, 1991) and the Sandinistas were removed from power in 1990 (Robinson, 1997). The conflict left 30,000 people dead (Kinzer, 1991), sent the Nicaraguan economy into decline, and destroyed infrastructure (Lancaster, 1992). The economic decline that resulted from the 1979 revolution and Contra War left Nicaragua with a staggering amount of debt. As discussed by Cupples et al. (2007:787), the debt crisis within Nicaragua, "unleashed a decisive and harmful spatial restructuring of governance and political power, which has exacerbated global inequalities and produced more intense forms of poverty and suffering in the global South."

Nicaragua's debt crisis opened the door for free market forces to penetrate the economy and promote agricultural privatization and exportation (Robinson, 1997). These monetary policies had a significant impact on the lower socioeconomic classes. Policies implemented after the debt crisis made it difficult for small-scale farmers to subsist and many were forced to sell their land to larger landowners (Cupples et al., 2007). Land consolidation led to vast inequalities in land holdings and a significant portion of agricultural workers being landless (Ravera et al., 2014). The result of these economic and agricultural changes was a shift away from agricultural production for internal consumption toward systems of land privatization and agricultural exportation in line with the liberalization of the food market (Ravera et al., 2014; Robinson, 1997). Accompanying this shift in rural land use was a surge in manufacturing, specifically textile manufacturing in urban zones, powered by the arrival of landless rural migrants seeking employment (Robinson, 1997).

The impacts of the rapidly changing political and economic structures in Nicaragua are still evident today. Textiles and agricultural products make up 50% of the country's exports with

beef, coffee, and gold accounting for the top three export commodities (CIA, 2021). The globalization of food production across LMICs has changed the food landscape in these contexts, which includes increased access to processed foods (Popkin, 2002). As a result of global shifts in economic and food policies, Nicaragua, like other countries, has experienced a rapid nutritional, and related, epidemiological transition.

Data for this study were collected in Los Robles (pop. 2000), a rural agricultural community located in the Department of Jinotega in the northern highlands of the country. This region is dedicated, in large part, to coffee production and the economy of Los Robles, like other rural communities in the area, is based in coffee growing, harvesting, processing, and selling (Grossberg, 2013; Villanuava et al., 1970; Springer, 2016). Coffee is a valuable cash crop that was introduced to Nicaragua in the early 19th century and has attained a high global value, but many coffee producers live in poverty (Bacon, 2005; Rudkoski, 2017). In Los Robles, coffee is grown by households on small plots of land or on larger farms and the majority of people in the community are employed on coffee farms during the picking season and rely on this as a major source of income (Brown, 2017; Rudkoski, 2017). Due to the seasonality of coffee production, households supplement their income with subsistence agriculture which includes beans and maize, the regional dietary staples (Brown, 2017). Some households also maintain small gardens where they grow carrots, cucumbers, squash, as well as other fruits and vegetables (Rudoski, 2017).

There are strong gender roles within Nicaragua tied to the machismo and marianismo cultural concepts; the marianismo concept (based on the veneration of the Virgin Mary) is tied to the idealization of motherhood as well as the childcare responsibilities within Latin America (Stevens, 1974). The manifestation of these gender roles results in women and children having

the worst health outcomes and the Department of Jinotega, the poorest region of Nicaragua, has the worst maternal and child health outcomes in the country (Brown, 2017; Instituto Nacional de Estadísticas y Censos (INEC), 2002). Men and women work picking coffee from December to March but from April to November, after the coffee picking season, men either raise and produce crops on their own farms, provide labor to other farms, or they leave Los Robles and go to Jinotega or other cities to find work (Rudkoski, 2017). Unfortunately, many men fail to find steady work situations (Nicaragua Community Health Connection, 2014). Women remain in the communities, care for local garden crops and are responsible for the care of children (Rudkoski, 2017).

A health clinic in Los Robles was opened in December of 2014 and it is staffed by a single doctor. Funding for the clinic is provided by Communidad Connect, a local non-governmental organization (Rudkoski, 2017). The clinic provides basic healthcare services. However, residents requiring a medical specialist (i.e., oncologist, urologist, endocrinologist etc.), must make a 1-hour bus trip to the capital city of Jinotega. The cost of the ticket is the equivalent of a day's wages (Rudkoski, 2017). Prior to 2014, the nearest clinic was in the neighboring town of Dantali, a two-hour walk from Los Robles (Rudkoski, 2017).

Sample

Data were collected between May and July of 2015 as part of a larger study of food security and maternal-child health. With the help of community health volunteers (*brigadistas*) from Los Robles, participants were recruited via convenience sampling if they met the inclusion criteria: female head of household with a child between 0-11 years old. The original sample included 254 women. For this study, we restricted inclusion to women who were non-pregnant

and over 18 years of age. Women with missing health data or who failed to provide an answer to the SRH question were also excluded, which resulted in a final sample of 200 women.

Data Collection

The research team consisted of faculty and graduate students from the University of Calgary and four female brigadistas who, together represented the fields of anthropology, public and community health. A local physician, Dr. Alaniz, served as a project advisor. Data were collected via a survey instrument and anthropometric measures. The survey was reviewed by and modified in accordance with input from the brigadistas, Dr. Alaniz, and community members. The face validity of the questionnaire was then tested via focus groups and mock interviews and further modifications were made to ensure it was relevant to and understood by women in the community.

Survey

The survey was used to gather information on demographic characteristics of the women including age, education, job status and household characteristics such as roof material, floor material, toilet type, primary water source, number of rooms in the house, home appliances, transportation type, number of children in the household, sources of income, land ownership and usage, and domesticated animal ownership. Included in the survey was the Latin American Food Security Questionnaire (ELCSA), a 15-question instrument to assess food scarcity resulting from insufficient income over the past three months (FAO, 2012). Scores on this instrument are based on the number of affirmative responses and scores range from 0-15 with higher scores indicating greater food insecurity (FAO, 2012).

The Self-Reporting Questionnaire (SRQ-20) was also included in the survey. The SRQ-20, a series of 20 questions that are answered yes or no, is used to evaluate individuals for symptoms of anxiety or depression and is validated for use within Nicaragua (Beusenberg and Orley, 1994). Scores on this instrument are based on the number of affirmative responses from the 20 questions with higher scores indicating greater mental distress (Piperata et al., 2016).

Anthropometric measures

Anthropometric measures included height (cm), weight (kg), waist circumference (cm), systolic and diastolic blood pressure (mmHg) and blood glucose level measures (mg/dl). All measures were collected by Dr. Warren Wilson, Dr. Alaniz, and the four North American graduate students following standardized protocols. Systolic blood pressure was taken three times while the participant was seated at rest with a five-minute break between measurements. To measure blood glucose, blood was drawn just prior to the interview with the blood glucose measurement (mg/dl) and time of the blood draw recorded. The non-fasting participant was then administered a 50.0 g oral glucose load after the initial blood draw. A second blood draw was then taken 1-hour later with the blood glucose measure (mg/dl) and time of second blood draw recorded. Some of the anthropometric measures were used to calculate indices including: Body Mass Index (BMI) (weight (kg/height (m^2)) and Waist-to-Height ratio (WHtR) (waist circumference (cm)/height (cm)).

Data Analysis

Chronic Disease Risk Index (CDRI)

To assess chronic disease risk, we developed a chronic disease risk index (CDRI) which was based on four commonly used indicators of chronic disease risk. The four measures included BMI, WHtR, systolic blood pressure and results of the oral glucose tolerance test. BMI is a commonly used indicator of overall fatness and chronic disease risk in adults (Browning et al., 2010). WHtR is a measure of abdominal/visceral adiposity (Browning et al., 2010). The metabolic activity of visceral adipose tissue has been correlated with type 2 diabetes, cardiovascular disease, hypertension, metabolic syndrome, and other chronic diseases (Kwon et al., 2017). Systolic blood pressure is used to assess individuals for hypertension because it measures the pressure exerted against the arteries during heart contraction (O'Rourke, 1989). The oral glucose tolerance test is used to detect impaired fasting glucose which is a risk factor for type 2 diabetes (Sinnott et al., 2015).

To develop the CDRI, we used international guidelines and existing literature to define cutoff values for the four measures of cardiometabolic risk (BMI, WHtR, systolic blood pressure, and blood glucose level). If the measure fell below the published cut-off value, the participant was scored as "0", if above, they were scored as "1". Scores were then summed to create the CDRI, which ranged from 0-4, with a higher score indicating greater risk for cardiometabolic disease. For BMI, the cut-off was ≥ 30.00, which is the definition of obesity (WHO, 2021). A WHtR >0.5 was used as the cut-off for high abdominal adiposity (Browning et al. 2010). For systolic blood pressure, the cut-off was >130 mmHg, which, among adult women, is indicative of hypertension (McGurnaghan et al. 2018). Finally, for blood glucose, the cut-off was >129.6 mg/dl, a marker of insulin resistance and, thus, diabetes risk (Bardini et al., 2009).

Statistical Analysis

Descriptive statistics were used to characterize the study participants. To test the relationship between self-rated health (SRH) and chronic disease risk index (CDRI), we used an ordinary least squares (OLS) regression model that included potential correlates of both SRH and CDRI (i.e., mental health (SRQ-20 score), marital status, breastfeeding status, and food security status). We ran a similar independent regression between SRH and the SRQ-20 scores to independently assess the relationship between SRH and mental health.

Statistical significance was determined using a two-tailed test ($p< 0.05$) and a power analysis where a $\beta \geq 0.2$ indicated that at least a moderate correlation was present between SRH and the CDRI and/or between SRH and mental health. We report this analysis by giving the β values along with the p-values for both regressions.

Ethics

Written, informed consent was collected before data were collected which typically took place in the participants' homes. If a participant was illiterate, verbal consent was witnessed and recorded by a *brigadista*. Participants were informed that they had the right to refuse to respond to any question and/or terminate the interview at any point in time without repercussions. No monetary compensation was provided, but participants were given information about their health. This project was approved by the Nicaraguan Ministry of Health (MINSA) (Ethics ID: NIC-MINSA/CNDR CIRE-25/05/15-060) and the Conjoint Health Research Ethics Board in the Faculty of Medicine at the University of Calgary (REB15-0232).

Results

Table 1 reports demographic characteristics of the women and the household conditions. The average age of the women in this study was 33 years and 87.5% of the women were married/cohabitating or had "other" marriage statuses while 12.5% of the women were single. The average number of children in the women's care was 2.6. At the time of data collection, 31% of the women were breastfeeding. The average number of rooms in the women's homes was 2.3. In terms of household construction, 92.5% of the women's homes had roofs made of zinc sheets while 7.5% were made of other materials and 54.5% of the homes had indoor toilets, 26.5% had outdoor toilets, 17.5% had no toilet, and 1.5% responded with "other". The average food security score was 3 (range from 0-15) where lower scores indicated greater food security.

TABLE 1: Characteristics of the women and household conditions (n=200).

Variable	Mean/%	SD	Min	Max
Women's characteristics				
Age (years)	32.7	10.0	19.6	70.3
Marriage status				
Married/union	83.5%			
Single	12.5%			
Other	4.0%			
Number of children	2.6	1.7	1	10
Breastfeeding (% yes)	31.0%			
Household Conditions	Mean/%	SD	Min	Max
Number of rooms	2.3	1.4	1	12
Roof type				
Zinc sheets	92.5%			
Ceramic tiles	4.0%			
Other	3.5%			
Floor type				
Tile	46.0%			
Dirt	45.5%			
Other	8.5%			
Water source				
Piped	82.0%			
Well	9.5%			
Other	8.5%			
Toilet				
Indoor toilet	54.5%			
Outhouse	26.5%			
None	17.5%			
Other	1.5%			

Table 2 reports descriptive statistics on women's health and anthropometric measures. The average height of the women was 152.8 cm. Average weight was 65.2 kg. The average BMI was 27.8 kg/m^2. The average waist circumference was 92.8 cm, and the average waist-to-height ratio was 0.6. The average systolic blood pressure was 115.7 mmHg and average blood glucose measurement was 132.4 mg/dl. For SRH, 3% of the women reported excellent health, 4%

reported very good health, 24.5% reported good health, 61% reported normal health, and 6.5% reported poor health.

In terms of the CDRI, only 4.5% of the women (n=9) did not exceed the cut-offs for any of the indicators of cardiometabolic disease risk. The chronic disease risk index was built using BMI, waist-to-height ratio, systolic blood pressure, and blood glucose measures as indictors of cardiometabolic disease risk and scores range from 0-4 with a higher score indicating greater cardiometabolic disease risk. For BMI, 28% of women (n=56) had a BMI greater than or equal to the cut-off of 30 kg/m^2. For waist-to-height ratio, 94.5% of women (n=189) had a value that exceeded the cut-off of 0.5. For systolic blood pressure, 10.5% of women (n=21) exceeded the cut-off of 130 mmHg. For blood glucose, 17% of the women (n=34) exceeded the cut-off of 129.6 mg/dl. The average number cardiometabolic disease risk factors found among the women was 2 and approximately 56% of the women exceeded cut-offs for 2 or more risk factors indicating that a large proportion of the study had multiple risk factors for cardiometabolic diseases. The average score of the SRQ-20 was 6.8 (possible scores range from 0-20) where higher scores indicate greater mental distress.

Table 2: Descriptive statistics of the women's health (n=200).

Variable	Mean/%	SD	Min	Max
Height (cm)	152.8	6.3	127.2	168.6
Weight (kg)	65.2	13.1	37.5	132.4
Waist circumference (cm)	92.8	11.2	65.2	145.3
BMI (kg/m^2)	27.8	5.1	17.7	53.5
Underweight (<18.5)	1.5%			
Normal weight (18.5-24.99)	31.5%			
Overweight (25-29.99)	39.0%			
[1]Obese (≥30)	28.0%			
Waist-to-height ratio	0.6	0.07	0.4	1.0
[2]Exceeds cut-off	94.5%			
Pulse rate (bpm)	76.9	10.5	51.0	113.3
Systolic blood pressure	115.7	13.9	82.3	210.0
[3]Exceeds cut-off	10.5%			
Diastolic blood pressure	73.4	9.5	51.7	115.3
Blood Glucose	132.4	26.8	80	220
[4]Exceeds cut-off	17.0%			
[5]Chronic Disease Risk Index	2	1	0	4
Self-reported health	3.7	0.8		
Excellent	3.0%			
Very good	4.0%			
Good	24.5%			
Normal	61.0%			
Poor	7.5%			
Mental Health Score	6.8	4.7	0	19
Diagnosed with a disease (% yes)	35.5%			
Self-rated activity level				
More active than others	65.5%			
As active as others	22.0%			
Less active than others	12.5%			

[1]BMI: The cut-off used to determine chronic disease risk was ≥30 which is considered obese (WHO)
[2]Waist-to-height ratio: The cut-off used to determine chronic disease risk was a 0.5. the cut-off for waist to height ratio was 0.5 (Savva 2013: 404)
[3]Systolic Blood Pressure: The cut-off for systolic blood pressure 130 was 130 mmHg which is indicative of stage 1 hypertension (McGurnaghan 2018: 721)
[4]Blood glucose: We used 129.6 mg/dl as our cut-off for the one-hour plasma glucose test as it is indicative for type 2 diabetes mellitus
[5]Chronic disease risk index: score range between 0 and 4. A point was given for having one of the factors if: BMI was greater than or equal to 30, or waist-to-height ratio, systolic blood pressure, or blood glucose exceeded the cut-offs.

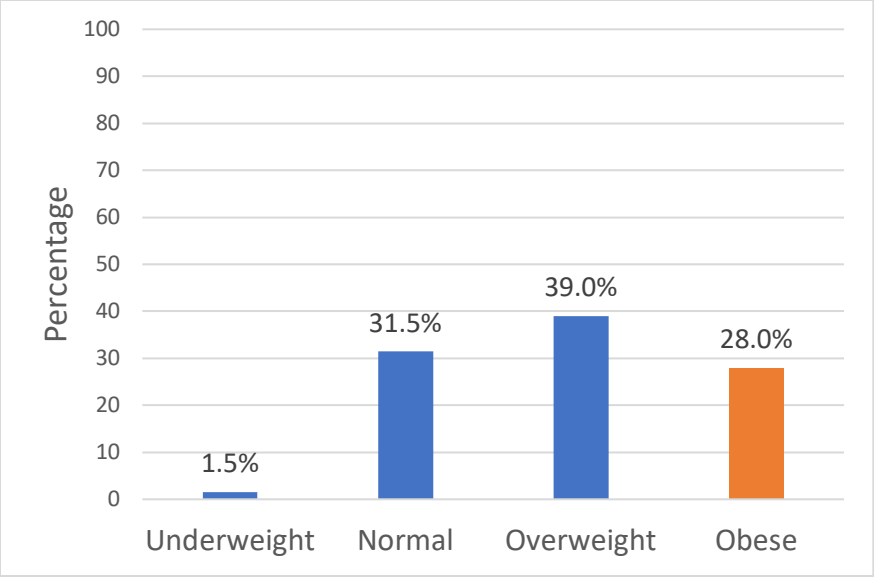

Figure 1: Body Mass Index Distribution

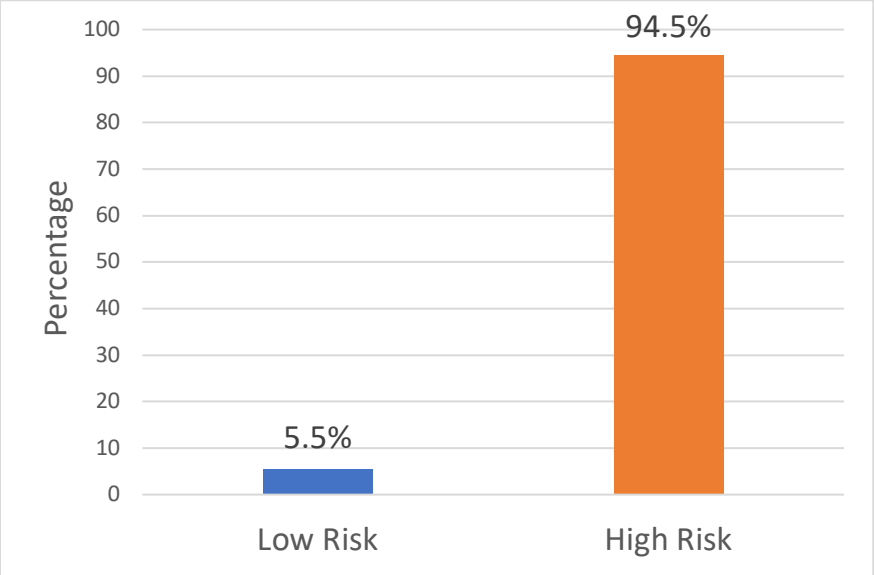

Figure 2: Waist-to-Height Ratio Score Distribution

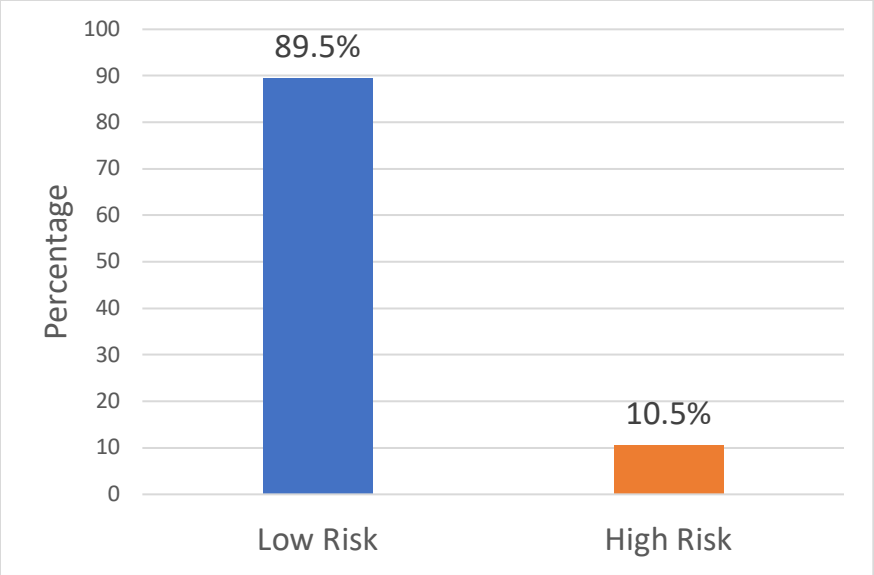

Figure 3: Systolic Blood Pressure Risk Score Distribution

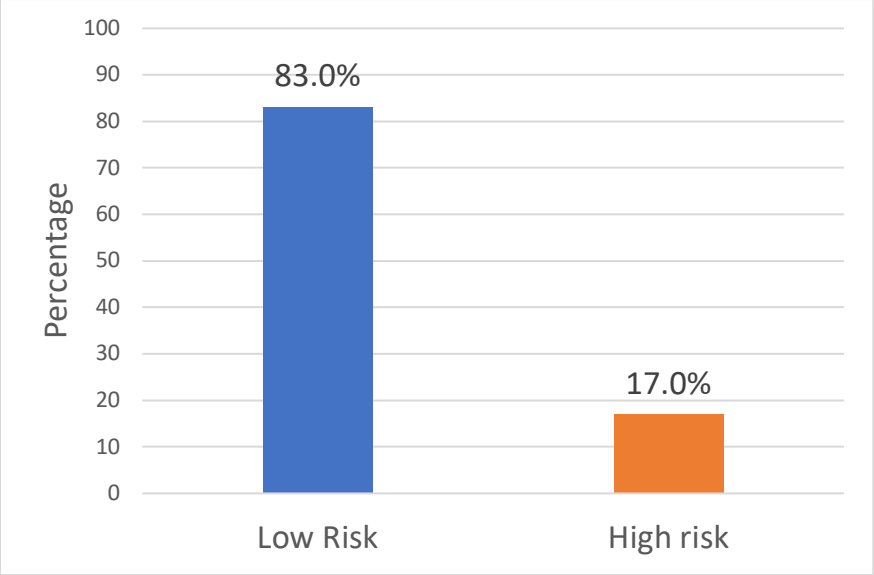

Figure 4: Blood Glucose Risk Score Distribution

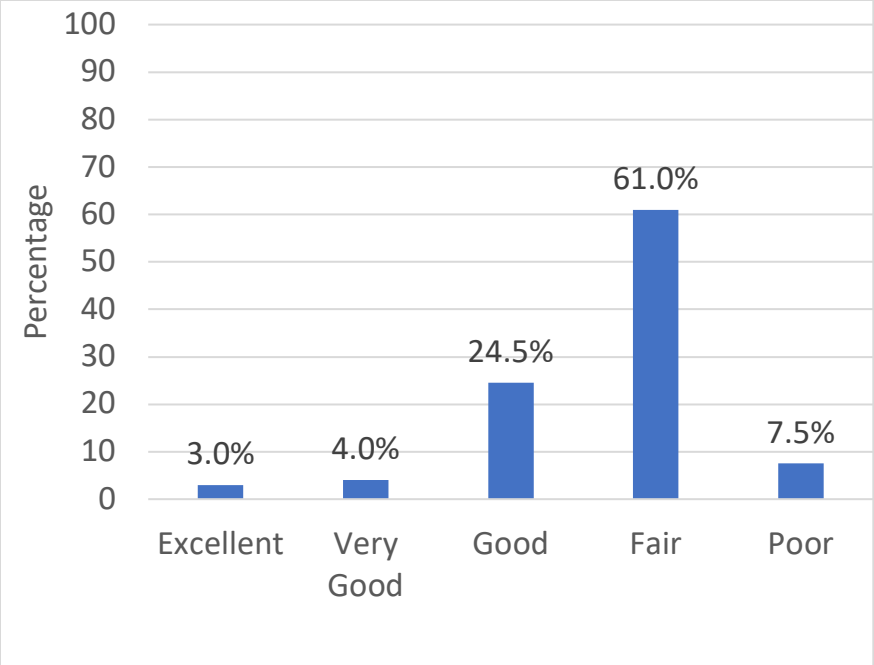

Figure 5: Self-Rated Health

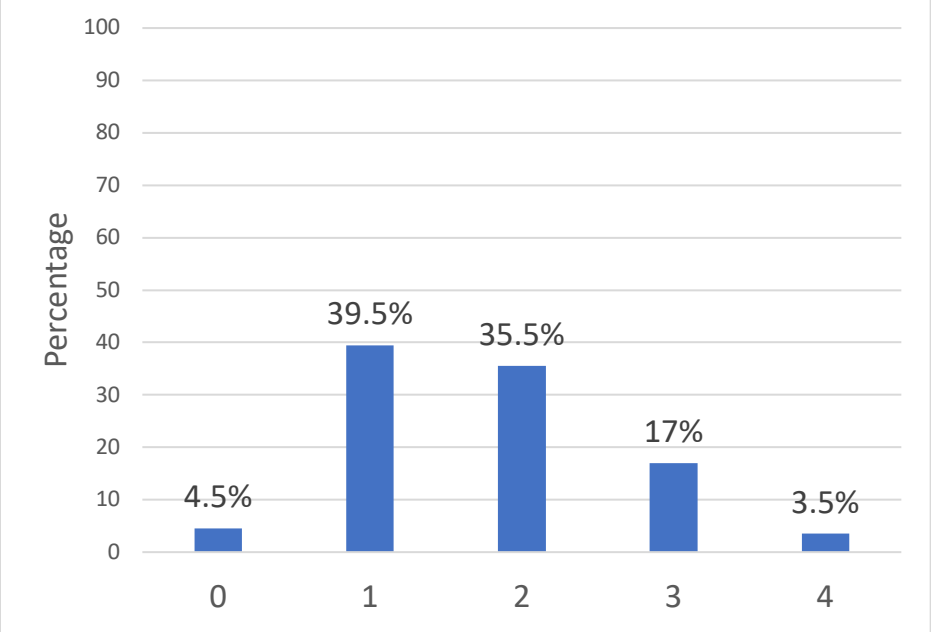

Figure 6: Chronic Disease Risk Index

An OLS regression model was used to test the relationship between SRH and the CDRI. We included potential correlates of both SRH and the CDRI and these correlates included mental

health status (SRQ-20 scores), marital status, breastfeeding and food security status. A similar model was used to independently test the relationship between SRH and mental health based on SRQ-20 scores. We found no association between SRH and the CDRI (β =0.057, p=0.48). This indicates that SRH is not predictive of cardiometabolic disease risk within this population of rural Nicaraguan women when controlling for mental health status, marital status, food security/ insecurity, and whether the women were breastfeeding at the time of data collection.

A notable result is that there was a moderate positive correlation (β =0.27, p=0.001) between mental health, as measured via the SRQ-20, and SRH. Since higher scores on the SRQ-20 indicate worse mental health symptoms and a higher score for SRH was correlated with worse self-perceptions of health, this indicates that worse mental health status is associated with poorer self-rated health.

Discussion

This study builds upon an existing base of literature focused on SRH and its use in countries experiencing rapid epidemiological transitions. This study demonstrated that the commonly used health indicator of SRH is not reliable within this sample of rural Nicaraguan women. Our results suggest that considerations for the physical, mental, cultural, and emotional components of SRH need to be taken into account when using SRH to evaluate a population's overall health and risk for chronic diseases such as cardiovascular disease or diabetes.

Chronic Disease Risk and Self-Rated Health

No association between the chronic disease risk index and SRH was found in our sample of Nicaraguan women. This finding contradicts a number of studies that suggest SRH is

predictive of morbidity and mortality (DeSalvo et al., 2006; Goldman, 2004; Heidrich, 2002; Idler and Kasl, 1991). Many studies that utilize SRH are focused on elderly study populations or occur in high-income "western" countries where SRH is predictive of morbidity and mortality (Holt et al., 2019; Mossey and Shapiro, 2011; Orimoloye et al., 2019; Perrucio et al., 2012; Wuorela et al., 2020). SRH is influenced by factors other than physical markers of health, but even when controlling for mental health status, marital status, breastfeeding status, and food security status, we found no association between cardiometabolic disease risk and SRH. As suggested by others, SRH is a subjective measure of health and is influenced by socioeconomic status, educational attainment, cultural definitions of health and well-being, physical activity, body image, age, mental health status, comorbidities and numerous other factors but these external and internal influences of SRH may make it a flawed indictor for cardiometabolic disease risk and morbidity and mortality profiles in contexts of rapid epidemiological transitions (Ansari and Berg-Beckhoff, 2019; Böhme and Renneberg, 2015; Fernandes et al., 2020; Noh et al., 2019; Tareque et al., 2015; Yaya and Bishwajit., 2020).

The disconnect between SRH and cardiometabolic disease risk in this population calls into question the reliability of SRH as a proxy for general health status and morbidity profiles in contexts where diseases like diabetes, cardiovascular disease, and hypertension are newly emerging alongside the existing burden of infectious disease (Au and Johnston, 2015). The women in our study live in a rural community reliant upon coffee growing for a large proportion of their income, have limited access to healthcare resources outside of a basic health clinic run by an NGO, and live in a country with an existing burden of infectious disease with a newly emergent burden of chronic disease (Alicea-Planas et al., 2016; CIA, 2021; Laux et al., 2012; Mascie-Taylor, 2012; WHO, 2016). Cultural perceptions and knowledge of health and health

risks are important to understand because they influence SRH and can mask underlying health issues that people are unaware of (Yates-Doerr, 2016). Multiple models of health exist outside of the prominent Western "medical disease model" that are more holistic and encompass different dimensions of health and wellbeing outside of physical health and these models can be influenced by the language used to describe one's health (Kandula et al., 2007).

While SRH had no association with chronic disease risk, our results indicate that there was an association between SRH and mental health status among the women in this study. The positive association between SRH and poorer mental health was a significant result. These results concur with several prior studies that found positive associations between mental health status and positive SRH (Conry et al., 2011; Harrington et al., 2009; Meyer et al., 2014). Our results are contradictory of Mavaddat et al. who found that mental health had less than half the association with SRH compared to physical function and SRH in adults from the United Kingdom (Mavaddat et al., 2011). SRH serves as a useful measure because, in a psychological sense, it integrates a person's attitude, emotional state including depressive or psychological distress, socioeconomic status, and social support network to evaluate their health (Mavaddat et al., 2011). Due to the integration of numerous facets of a person's life and experiences, SRH may serve as a strong proxy for mental health status within the same context it does not serve as a proxy for cardiometabolic disease risk.

Study Limitations and future research

The limitations of this study as well as our key findings may provide opportunities for future research projects. First, our sample size was relatively small and given that the study was cross-sectional, we cannot fully capture all the factors that influenced women's perceptions of

their health or their cultural values and knowledge surrounding health and well-being. Second, factors such as social support, food insecurity, educational status, and other key determinants of health were not included in our OLS regression. Future research should focus on how chronic disease within these contexts of rapid epidemiological transitions factor into peoples' perceptions of health and wellbeing and should include ethnographic data to capture how it impacts their daily lives (Yates-Doerr, 2016).

Conclusion

We evaluated the relationship between self-rated health and chronic disease risk among a sample of rural Nicaraguan women experiencing an epidemiological and nutritional transition to test if SRH was an effective proxy for cardiometabolic disease risk amongst these women. We found no association between SRH and cardiometabolic disease risk, but we did find an association between poor SRH and worse mental health status. Our findings call into question whether or not SRH is a reliable proxy for general health status of populations in contexts where there are rapid economic, nutritional, and epidemiological transitions that are impacting people's health.

In conclusion, considering the rapid epidemiological transitions occurring in LMIC globally, we argue that SRH alone is not an effective proxy for the general health of these populations and that more comprehensive measures of health are needed to effectively evaluate people's health within these contexts.

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